

## SUSTAINABLE GREEN BUILDING ENVIRONMENT

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### ABSTRACT

Construction industry is one of the industry which uses largest quantities of natural resources throughout it's life span. That is starting from construction, site selection and land use and after completion, water bodies, lighting, ventilation, maintenance etc. In each of these cases we are using natural resources but nowadays these resources are diminishing rapidly and it's the time to go for the sustainable development that is to preserve these natural resources for our future generations. In order to conserve all these natural resources here comes the concept of green building.

Generally, the green building is considered to be an environmental component, as the green building materials are manufactured from local eco-sources, i.e. environmentally friendly materials, which are then used to make an eco-construction subject to an eco-design that provides a healthy habitat built on the cultural and architectural heritage in construction while ensuring conservation of natural resources. This ensures disassembling the building components and materials, after a determined building lifetime, to environmentally friendly materials that can be either re-used or recycled. During their lifecycle, the green buildings minimize the use of resources (energy and water); reduce the harmful impact on the ecology, and provide better indoor environment.

Sustainability was defined nearly thirty years ago as 'progress that serves the needs of the present without compromising the ability of future generations to meet their own needs'. Today, population growth, finite resources and recognition of climate pattern anomalies possibly resultant from resource depletion and fossil fuel combustion gases are motivating architects, builders, designers and owners to demand products that use resources wisely. This social consciousness and the financial reality of increasing energy costs has dramatically shortened payback periods for investment in sustainable alternatives, so that, put simply, it pays to be green.

So in this paper author discusses in detail that what is the green building and what is the difference between green bldg. and ordinary bldg. what are the objectives to go for green building? How to achieve these concept? And what are the measures or how we came to know that our construction is going towards green building concept.

**KEYWORDS:** Green Building, Natural Resources, Energy, Water Use, Sustainability

### INTRODUCTION

Construction industry is one of the industries which use largest quantities of natural resources throughout its life span. That is starting from site selection, land use, construction, and even after completion it requires water resources, lighting, ventilation, maintenance etc. to continue the existence of building in a proper manner. Our buildings use enormous amount of energy, water, and material throughout their life cycle. But nowadays these resources are diminishing

rapidly and it's the time to go for the sustainable development that is to preserve these natural resources for our future generations. In order to conserve all these natural resources here comes the concept of green building.

According to WCED, (World Commission of Environment and Development), 1987, sustainable development is defined as ".to meet the needs of the present without compromising the ability of future generations to meet their own needs." "Sustainable Development" is a necessary condition for continuation of the earth; "Healthy and Comfortable" is a necessary condition for the continuation of life.

Global warming and climate changes have become a major concern for mankind today. In order to ensure that, development and environment conservation go hand in hand, major corporations around the world are empowering projects to slow down depletion of natural resources.

The economic, health and environmental impact of our homes is apparent in our society. To meet the challenges of our built environment, a new way of designing & construction has evolved. It's a Green Building, this system follows design and construction practices that significantly reduce or eliminate the negative impact of the building on the environment and the occupants.

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## **Definition**

So, here various definitions are given to know the meaning of green building, "Green building" is a way of enhancing the environment. It benefits humans, the community, the environment, and a builder's bottom line. It is about tailoring a building and its site to the local climate, site conditions, culture and community, in order to reduce resource consumption while enhancing quality of life." Another definition says that, "A green building is one whose construction and lifetime of operation assure the healthiest possible environment while representing the most efficient and least disruptive use of land, water, energy and resources. The optimum design solution is one that effectively emulates all of the natural systems and conditions of the pre-developed site – after development is complete."

Green buildings exhibit a high level of environmental, economic and engineering performance. These include energy efficiency and conservation, improved indoor air quality, resource and material efficiency, and occupant's health and productivity. Kamana and Escultura (2011) defined "sustainable building" or "green building" as an outcome of a design which focuses on increasing the efficiency of resource use energy, water, and materials - while reducing building impacts on human health and the environment during the building's lifecycle, through better location, design, construction, operation, maintenance, and removal. Pan et al. (2011) added that a green building is an outcome of a design philosophy which focuses on increasing the efficiency of resource use.

Green Building, also known as Sustainable Building, is the practice of creating structures and using processes that are environmentally responsible and resource-efficient. The aim of designing a Green Building is to reduce the overall impact of the built environment on human health and the natural environment. This is represented by following triangle in figure1,



**Figure 1: Concept of Green Building**

The terms “green” and “green building” applies to construction strategies, building design and orientation, landscaping, building operations, maintenance, and more. The less impact a building has on human health and the environment, the more green it is. A green building is designed, constructed and operated to minimize the total environmental impacts while enhancing user comfort and productivity. Chatterjee (2009) defined the “green building practice” as a process to create buildings and infrastructure in such a way that minimize the use of resources, reduce harmful effects on the ecology, and create better environments for occupants.

Green building incorporates integrated design concepts, solar orientation, appropriate footprint sizing, glazing awareness, material durability, economic life-cycle analysis, material reuse and salvage, natural material content, locally available materials and economic sustainability.

## GREEN BUILDINGS VS CONVENTIONAL BUILDINGS

The environmental impacts of buildings are enormous. Conventional buildings use large amounts of energy, land, water, and raw materials for their construction and operation. They are responsible for large greenhouse gas (GHG) emissions as well as emissions of other harmful air pollutants. Electric lighting consumes about one-quarter to one-third of the energy in a typical commercial building. Lighting also generates heat, so reducing the amount of energy consumed for lighting through effective and efficient lighting also reduces the size of a building’s air-conditioning plant. They also generate large amounts of construction and demolition (C&D) waste and have serious impacts on plants and wildlife. An analysis of these issues demonstrates the scope of the problem.

### Green Techniques

Emphasis of four ‘R’s:-Via sound designing, construction and building commissioning without compromising structural durability, indoor pollutant levels, ventilation, building code requirements, or marketability includes:-

**Reduce:** - lower quantity of building material, resources, and embodied energy are used.

**Reuse:**-construction materials that are practical and structurally sound are reused.

**Recycle:** - recycled materials are used, and home is designed for recyclables.

**Renewable:** - energy from natural sources and renewable building materials are emphasized. The technique which emphasizes these four ‘R’s are called as Green Techniques. These Green techniques can be classified as follows:

## **Structural or Civil Techniques**

Investing in energy-efficient options, such as insulation, will provide a continued payback to the homeowner and a more enjoyable and comfortable living environment for many years, as well as a reduction in emission of greenhouse gases. Use of Insulated wall such as air gap insulation, cotton insulation, mineral wool insulation, plastic fiber insulation will be helpful in this case.

Green Cement, Fly ash brick, transparent roof / sustainable day lighting, Green Roofs, Green Paints, Eco Wood, and Green Glasses are some of the other green building materials. And using these recyclable materials we are able to produce a green building

## **ELECTRICAL TECHNIQUES**

- **Conservation Techniques**

To conserve the electrical energy we can use different measures such as optimum use of natural light, replacing incandescent lamps by compact fluorescent lamps (CFL's), replacement of conventional fluorescent lamp by energy efficient fluorescent lamp, replacing of mercury/sodium vapour lamp by halides lamp, Replacing HPMV lamps by high pressure sodium vapour lamps, Replacement of luminaries by more energy efficient luminaries, replacement of conventional ballast by energy efficient ballast, obtain flexibility in light control circuit by using sensors, microprocessors.

- **Generation Techniques**

In new construction, there is a provision to generate electricity by Solar Lighting as well as by Solar-Wind Hybrid system and in this way the green building becomes zero energy building. Zero energy buildings are defined as buildings that produce as much energy as they consume over a full year.

'Zero energy' states that the energy produced on-site through renewable sources (such as wind, sun) is equal to the energy used by the building when annual accounting is done.

- **Special Systems/ Techniques**

Grey water Management, Afforestation surrounding the building, Rain water harvesting including collecting rain water, purifying it to an extent, directing it to subsoil spaces below the plot where it can be stored, by gravity or mechanical means. Then comes the passive solar heating and cooling means building's windows, walls, and floors can be designed to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer and Prevention of soil erosion to reduce or eliminate runoff due to impervious (watertight) surfaces are some of the special measures to make the building green.

It is explained in much detail in figure 2 that how to make use of natural resources wisely and to make a building green.

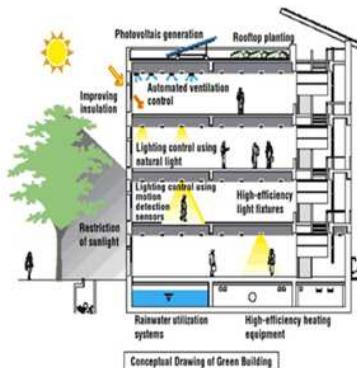
## **ELEMENTS OF GREEN BUILDING DESIGN**

Major elements regarding design and construction of green building are as discussed below,

### **Sustainable Site Design**

This can be achieved by minimizing urban sprawl and needless destruction of valuable land, habitat and green

space, which results from inefficient low-density development. Encourage higher density urban development, urban re-development and urban renewal, and brownfield



**Figure 2: How to Make a Building Green.**

Development as a means to preserve valuable green space. Preserve key environmental assets through careful examination of each site. Engage in a design and construction process that minimizes site disturbance and which values, preserves and actually restores or regenerates valuable habitat, green space and associated eco-systems that are vital to sustaining life.

### Water Quality and Conservation

Preserve the existing natural water cycle and design site and building improvements such that they closely emulate the site's natural "pre-development" hydrological systems. Emphasis should be placed on retention of storm water and on-site infiltration and ground water recharge using methods that closely emulate natural systems. Minimize the unnecessary and inefficient use of potable water on the site while maximizing the recycling and reuse of water, including harvested rainwater, storm water, and gray water.

### Energy and Environment

Minimize adverse impacts on the environment (air, water, land, natural resources) through optimized building siting, optimized building design, material selection, and aggressive use of energy conservation measures. Resulting building performance should exceed minimum International Energy Code (IEC) compliance level by 30 to 40% or more. Maximize the use of renewable energy and other low impact energy sources.

### Indoor Environmental Quality

Provide a healthy, comfortable and productive indoor environment for building occupants and visitors. Provide a building design, which affords the best possible conditions in terms of indoor air quality, ventilation, and thermal comfort, access to natural ventilation and day lighting, and effective control of the acoustical environment.

### Materials and Resources

Minimize the use of non-renewable construction materials and other resources such as energy and water through efficient engineering, design, planning and construction and effective recycling of construction debris. Maximize the use of recycled content materials, modern resource efficient engineered materials, and resource efficient composite type structural systems wherever possible. Maximize the use of re-usable, renewable, sustainably managed, bio-based

materials. Remember that human creativity and our abundant labor force is perhaps our most valuable renewable resource. The best solution is not necessarily the one that requires the least amount of physical work.

## **TYPICAL GREEN BUILDING GUIDELINE ISSUES**

In which way we can achieve these green building issues can best be explained in following paras,

### **Energy Efficiency and Renewable Energy**

It can be achieved by Building orientation to take advantage of solar access, shading, and natural lighting, considering the effect of micro-climate on building, Thermal efficiency of building envelope and fenestration and properly sized and efficient heating, ventilating, and air-conditioning (HVAC) system

### **Alternative Energy Sources**

It can be achieved by minimization of electric loads from lighting, appliances, and equipment, Utility incentives to offset costs, considering Direct and indirect environmental impact Integrity of site and vegetation during construction, Use of integrated pest management, Use of native plants for landscaping, minimization of disturbance to the watershed and additional non-point-source pollution, Effect of materials choice on resource depletion and air and water pollution, Use of indigenous building materials and amount of energy used to produce building materials.

### **Resource Conservation and Recycling**

It can be achieved by Use of recyclable products and those with recycled material content, Reuse of building components, equipment, and furnishings. Minimization of construction waste and demolition debris through reuse and recycling, Easy access to recycling facilities for building occupants, Minimization of sanitary waste through reuse of gray water and water-saving devices, Use of rainwater for irrigation, Water conservation in building operations, Use of alternative wastewater treatment methods

### **Indoor Environmental Quality**

Occupant's healthy environment can be achieved by minimizing the use of volatile organic compound content of building materials, opportunity for microbial growth. Minimization of business-machine, chemical content and volatility of maintenance and cleaning materials, and occupant pollution sources. Other measures to provide healthy living conditions are adequate fresh air supply, adequate acoustic control, access to daylight and public amenities.

### **Community Issues**

The points to be considered in community issues are access to site by mass transit and pedestrian or bicycle paths, attention to culture and history of community, climatic characteristics as they affect design of building or building materials, local incentives, policies, regulations that promote green design, Infrastructure in community to handle demolition-waste recycling and regional availability of environmental products and expertise

## **GREEN BUILDING RATING SYSTEMS**

Building rating systems are a popular tool to bring momentum in achieving energy efficiency and sustainability in buildings. The country has currently two rating systems namely, LEED and GRIHA.

### **Leadership in Energy and Environmental Design (LEED)**

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed and managed by the USGBC, is the most widely used rating system in North America. Buildings are given ratings of platinum, gold, silver, or “certified”, based on green building attributes. The Indian Green Building Council (IGBC) founded by the collaboration between the Confederation of Indian Industry (CII) and the private manufacturer Godrej, has taken steps to promote the green building concept in India. Currently, IGBC is facilitating the LEED rating of the U.S. Green Building Council in India. LEED-India was launched in 2001 and rates buildings on environmental performance and energy efficiency during the design, construction and operation stages.

### **Green Rating for Integrated Habitat Assessment (Griha)**

The Ministry of New and Renewable Energy have adopted a national rating system- GRIHA which was developed by The Energy and Resources Institute (TERI). It is an indigenously developed rating system completely tuned to the climatic variations, architectural practices, existing practices of construction and attempting to revive the passive architecture. The GRIHA rating system takes into account the provisions of the National Building Code 2005, the Energy Conservation Building Code 2007 announced by BEE and other IS codes. This was developed specifically aimed at non-air conditioned or partially air conditioned buildings. GRIHA has been developed to rate commercial, institutional and residential buildings in India emphasizing national environmental concerns, regional climatic conditions and indigenous solutions.

GRIHA stresses passive solar techniques for optimizing visual and thermal comfort indoors<sup>20</sup> and encourages the use of refrigeration-based and energy-demanding air conditioning systems only in cases of extreme thermal discomfort.

### **Case Study**

One of the best example of five Star GRIHA Rated Building is IIT Kanpur Centre for Environmental Sciences and how they achieve that green building concept is explained in following figures.

#### **IIT Kanpur Centre for Environmental Sciences: 5 Star GRIHA Rated Building**



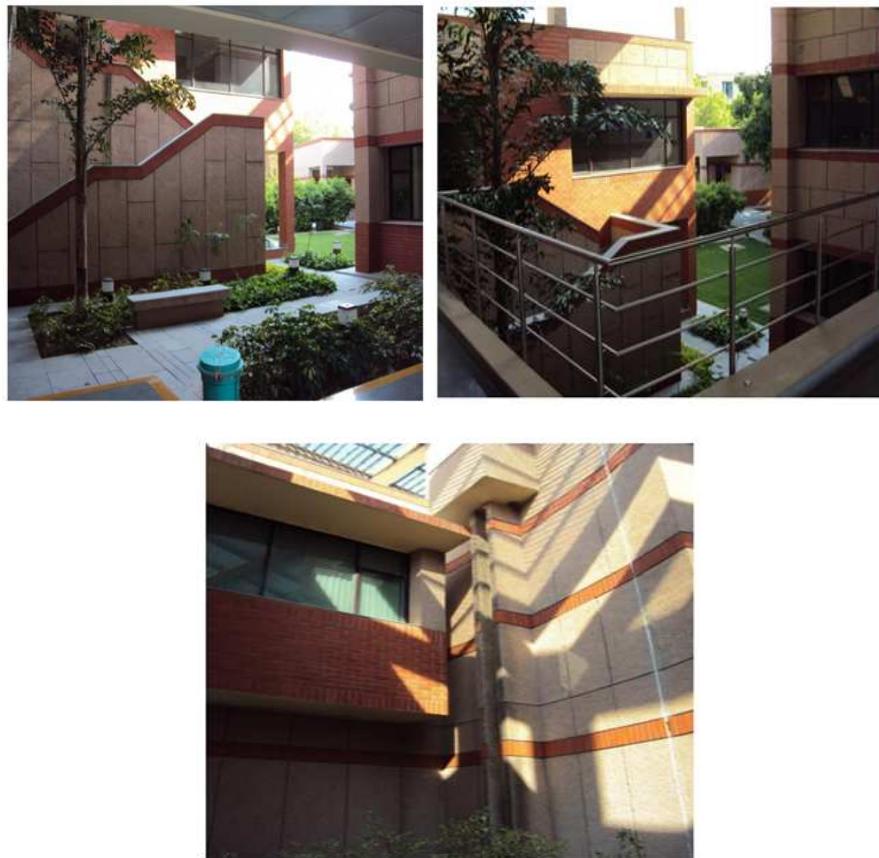
**Figure 3: IIT Kanpur Centre for Environmental Sciences: Inner Courtyards**

Optimum orientation and architectural design for reduced energy consumption and maximum comfort

Efficient landscape design for improved microclimatic conditions

EAT system for pre cooling of fresh air

Solar Photo Voltaic to meet 30% of lighting energy consumption



**Figure 4: Natural Shades on Walls and Windows**

## CONCLUSIONS

In an environmentally stressed world, green buildings are moving from an exotic curiosity to a necessity. Buildings are perhaps the single greatest stress on the environment, accounting for the world's fresh water withdrawals, one-quarter of its wood harvest, and two fifths of its material and energy flows. In such a scenario of shortages of clean water and other materials, and the possibility of devastating climate change, the greening of buildings constitutes a collective vital. Given the political difficulties of obtaining energy, and likely future shortages of conventional energy sources, we cannot ignore the enormous conservation that green buildings make possible. And buildings with natural materials and lighting also create a happier, healthier, more productive atmosphere.

At present, ecological awareness is an issue of rising global importance. The concepts of sustainable building make invaluable contributions in the efforts to control and reduce the effects of global warming and climate change. In this atmosphere it becomes the responsibility of industries, businesses and individuals to make informed and proactive contributions to reduce the negative output of development.

Last but not least, 'A Green building creates Delight when you enter, Serenity and health when occupied Serenity and health when occupied & Regret while you depart'

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